Association of Lower Continuity of Care With Greater Risk of Emergency Department Use and Hospitalization in Children

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ABSTRACT. *Context.* **The benefits of continuity of pediatric care remain controversial.**

Objective. **To determine whether there is an association between having a continuous relationship with a primary care pediatric provider and decreased risk of emergency department (ED) visitation and hospitalization.**

Design. **Retrospective cohort study.**

Setting and Population. **We used claims data from 46 097 pediatric patients enrolled at Group Health Cooperative, a large staff-model health maintenance organization, between January 1, 1993, and December 31, 1998, for our analysis. To be eligible, patients had to have been continuously enrolled for at least a 2-year period or since birth and to have made at least 4 visits to one of the Group Health Cooperative clinics.**

Main Exposure Variable. **A continuity of care (COC) index that quantifies the degree to which a patient has experienced continuous care with a provider.**

Main Outcome Measures. **ED utilization and hospitalization.**

Results. **Compared with children with the highest COC, children with medium continuity were more likely to have visited the ED (hazard ratio [HR]: 1.28 [1.20–1.36]) and more likely to be hospitalized (HR: 1.22 [1.09–1.38]). Children with the lowest COC were even more likely to have visited the ED (HR: 1.58 [1.49–1.66]) and to be hospitalized (HR: 1.54 [1.33–1.75]). These risks were even greater for children on Medicaid and those with asthma.**

Conclusions. **Lower continuity of primary care is associated with higher risk of ED utilization and hospitalization. Efforts to improve and maintain continuity may be warranted.** ***Pediatrics* 2001;103:524–529;** ***continuity of patient care, pediatrics, ambulatory care, emergency department, hospitalization.***

ABBREVIATIONS. COC, continuity of care (index); ED, emergency department; HMO, health maintenance organization; GHC, Group Health Cooperative; PCDS, pediatric chronic disease score; ICD-9, *International Classification of Diseases, Ninth Revision*; HR, hazard ratio.

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Having a regular primary care physician has long been thought to be an important component of maintaining patients' health.[1] However, evidence in support of this assertion has been sparse and somewhat contradictory. Studies in adult patients have demonstrated some benefits of increased continuity of care (COC),[2,3] but studies in children have been limited and have led to conflicting conclusions.[4–11]

This paucity of data regarding COC for pediatric patients persists at a time when the stability, consistency, and longevity of patient-physician relationships are receiving greater attention.[1] The recent increase in managed care may both enhance and endanger COC.[12,13] For example, certain features of managed care, such as the assignment of primary providers to all enrollees, might serve to increase COC[12,14] whereas other features, such as the use of nurse practitioners or physician assistants when they function as adjunct rather than primary providers, might diminish it.[15–17] Moreover, the organization of physicians into larger groups or practice networks might decrease opportunities for consistent contact between patients and a specific provider.[18,19] Finally, cost containment strategies on the part of both employers and insurance companies have led to shifting patient allegiances with physician practices and networks, which can necessitate that patients change providers thereby potentially severing established relationships.[18]

Previously, we have found that increased attending physician COC was associated with decreased emergency department (ED) utilization for Medicaid children cared for in a resident teaching clinic.[6] That study had 2 principal limitations. First, the sample size was too small to evaluate rare outcomes such as hospitalizations. Second, the unusual features of a teaching clinic hampered that study's generalizability to other clinical venues. We, therefore, undertook a large retrospective cohort study of children within a single health maintenance organization (HMO). Our goals were twofold; first, to evaluate the association between decreased COC and increased ED utilization and hospitalization; and second to test the hypothesis that the risks of poor COC are more pronounced for children with asthma, a prevalent and ambulatory care-sensitive pediatric disease.

METHODS

Setting and Providers

Group Health Cooperative (GHC) of Puget Sound is a large, staff-model HMO with approximately 530 000 members. Its auto-

mated databases contain comprehensive inpatient and ambulatory care records, including unique patient and physician identifiers, and have been used for a wide range of epidemiologic and health services research.[20] The information from these databases enabled us to assess continuity of primary care as well as hospital and ED utilization for each member.

Patients

Children in this study were born between January 1, 1980 and December 31, 1996. To be eligible for inclusion, patients had to be <18 years old and have been continuously enrolled for at least 2 years or since birth and to have made at least 4 visits to a GHC clinic.

Outcome Variables

Our main outcomes were an ED visit or a hospital admission. Because children who are hospitalized are often seen in an ED immediately before admission, we constructed independent models for each of these events for the purposes of our analysis. For each outcome of interest, patients contributed data until their first ED visit or hospitalization or until the end of the study period (December 31, 1998).

Exposure Variables

Continuity Measure

Our primary predictor variable was an index of COC. Several such indices have been developed.[21–23] We opted to use the COC index developed by Bice and Boxerman[23] that is derived from Rae and Taylor's index of fragmentation[24] and is of the general form:

$$\mathrm{COC} = \frac{\sum_{j=1}^{s} n_j^2 - N}{N(N-1)}$$

where N = total number of visits
n = number of visits to provider j
s = number of providers

The COC takes on values between 0 and 1. A value of 0 signifies maximum dispersion, which occurs when a different provider is seen for every visit. A value of 1 signifies minimum dispersion, which occurs when the same provider is seen at every visit. To demonstrate the behavior of the COC, several hypothetical patterns each involving 8 visits are shown in Table 1. Note that as the contacts with providers become more dispersed—from all visits with Provider A to every visit with a different provider—the COC moves from 1 to 0. We calculated patients' COC indices based only on visits to primary care pediatricians or family physicians. Visits to specialists or subspecialists were not included in computing the COC index.

In our previous study,[6] we found that the COC index became more stable, that is, less subject to significant change as a result of minor perturbations in care dispersion as the number of visits increased. We, therefore, restricted our analysis to patients with 4 or more visits to primary care physicians. This decision was in keeping with the construct underlying continuity because meaningful COC cannot exist when visits are exceedingly few.

COC indices were calculated at the time of patients' first ED visit or hospitalization. If a patient had neither of these outcomes, COC was calculated at the time corresponding to the end of the study.

TABLE 1. Example of the COC

Visit Sequence*	COC Index
AAAAAAAA	1.0
AAAABAAA	0.75
ABAABAAA	0.57
ABAACAAA	0.54
ABCBAEFA	0.23
ABCDEFGH	0

* Each letter corresponds to a separate provider.

Covariates

We controlled for disease severity in our statistical models in 3 ways. First, we included the total number of outpatient visits as a covariate. Total outpatient visits might be associated with either severity of illness or with propensity to seek care, both of which could increase the risk of ED use or hospitalization. Second, we controlled for the presence of asthma in patients because it is by far the most prevalent chronic disease in children[25] and is known to be associated with both ED utilization and hospitalization. As others have done, we identified children with asthma based on having at least 2 visits at which an *International Classification of Diseases, Ninth Revision* (ICD-9) code for asthma (493.0–493.9) was used during our study period.[26]

Finally, we included a pediatric chronic disease score (PCDS) that has been developed and validated on GHC patients.[27] Based on pharmacy fills, the PCDS measures health status by flagging both medications and the frequency with which they are dispensed over a 1-year period to create a severity indicator.

The PCDS has been shown to perform as well as ICD-9 codes alone at predicting subsequent costs of care.[27] Its theoretical range is approximately 0 to 100 000. For simplicity, we divided our scores by 1000.

In addition to these covariates, we controlled for gender, age, and Medicaid status. GHC does not collect data on race or ethnicity; however, a recent internal study found their demographics to be similar to the Seattle metropolitan area (unpublished data).

Statistical Analysis

Because children's length of enrollment varied as did the time at which they were hospitalized or used the ED, we performed survival analysis using Cox proportional hazards regression on censored data. Individuals were included while they were at risk for our outcomes of interest. We analyzed subgroups of children with asthma and those on Medicaid separately.

The COC was modeled as a time-dependent covariate because its value changes with each outpatient visit.[28] We modeled our main predictor (COC) as both a continuous variable and as dummy variables using tertiles derived from our entire sample. In both cases, it was significant and although the model χ^2s were slightly better for the continuous models, we have opted to present the ones based on the tertiles because they are more intuitive given that the value associated with COC has no inherent meaning.

To test the hypothesis that there was a dose-response relationship between increased COC and decreased risk of ED utilization and hospitalization, a trend test was used.[29]

All analyses were conducted using Stata 6.0 (Stata Corporation, College Station, TX).

RESULTS

There were 46 097 patients who met our eligibility criteria. Table 2 summarizes the characteristics of included patients. The mean age of patients was 5.1 years; 52% were male. Approximately 20% of children had ED visits and 3.8% were hospitalized. More than 3% were covered by Medicaid at some point during the study period and 7.7% met our criteria for a diagnosis of asthma. The mean PCDS was 0.91 (range: 0–47). The mean raw COC index was 0.39.

In a survival analysis model that used the highest continuity tertile as a referent and adjusted for age, sex, Medicaid status, underlying asthma, total outpatient visits, and chronic disease score, children in the medium continuity tertile were 28% more likely to have visited the ED (hazard ratio [HR]: 1.28 [1.20–1.36]) and 22% more likely to be hospitalized (HR: 1.22 [1.09–1.38]). Children in the lowest continuity tertile were even more likely to have visited the ED (HR: 1.58 [1.49–1.66]) and to be hospitalized (HR: 1.54 [1.33–1.75]). Children covered by Medicaid were more likely to visit the ED overall, although the benefits of increased COC were not dramatically dif-

TABLE 2. Summary of Included Patients

Variable	Total Sample $N = 46\,097$	ED Visitors $N = 7169$	Hospitalized Children $N = 1670$
Mean age (SD)	5.1 y (4.1)	5.1 y (4.4)	5.4 y (4.5)
Male, *n* (%)	23 725 (52)	3656 (51)	868 (52)
Mean number of outpatient visits (SD)	10.0 (9.4)	10.2 (8.2)	10.9 (9.2)
Mean PCDS[27] (SD)	0.91 (1.2)	.98 (1.5)	1.21 (2.52)
Medicaid, *n* (%)	1541 (3.3)	318 (4.4)	64 (3.8)
Asthma, *n* (%)	3559 (7.7)	969 (13.5)	342 (20.0)
Mean COC index (SD)	0.39 (0.32)	.31 (0.24)	.33 (0.24)

SD indicates standard deviation.

TABLE 3. Cox Proportional Hazard Model of ED Visitation (All Children)

Variable	All Children HR [95% CI]	Non-Medicaid HR [95% CI]	Medicaid HR [95% CI]
Continuity			
High (0.41–1.0)	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Medium (0.19–.40)	1.28 [1.20–1.36]	1.28 [1.20–1.36]	1.11 [0.85–1.51]
Low (0–0.18)	1.58 [1.49–1.66]	1.61 [1.50–1.72]	1.40 [1.02–1.92]
Total outpatient visits	1.03 [1.02–1.04]	1.03 [1.02–1.04]	1.05 [1.04–1.07]
Age (y)	.91 [.87–.93]	.89 [0.88–0.90]	0.99 [0.96–1.03]
Medicaid	1.89 [1.67–2.12]	NA	NA
Female sex	.88 [.84–.93]	.88 [0.84–0.93]	0.83 [0.76–0.90]
Asthma	1.56 [1.45–1.68]	1.53 [1.43–1.63]	2.40 [2.17–2.69]
PCDS*	1.02 [1.00–1.03]	1.03 [1.01–1.04]	1.09 [1.05–1.13]

CI indicates confidence interval.

TABLE 4. Cox Proportional Hazard Model of Hospitalization (All Children)

Variable	All Children HR [95% CI]	Non-Medicaid HR [95% CI]	Medicaid HR [95% CI]
Continuity			
High (0.39–1.0)	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Medium (0.19–0.38)	1.22 [1.09–1.38]	1.22 [1.09–1.38]	1.04 [.54–1.96]
Low (0–0.18)	1.54 [1.33–1.75]	1.54 [1.30–1.76]	1.61 [1.01–3.03]
Total outpatient visits	1.04 [1.04–1.05]	1.04 [1.04–1.05]	1.03 [1.00–1.06]
Age (y)	.94 [0.93–0.96]	.94 [0.93–0.96]	0.95 [0.93–0.96]
Medicaid	1.37 [1.04–1.80]	NA	NA
Female sex	1.01 [.92–1.12]	1.01 [.92–1.12]	0.85 [0.48–1.51]
Asthma	2.12 [1.87–2.42]	2.12 [1.85–2.43]	2.34 [1.19–4.61]
PCDS*	1.07 [1.05–1.09]	1.07 [1.05–1.08]	1.13 [1.09–1.17]

CI indicates confidence interval.

ferent for them versus the entire sample (Tables 3 and 4).

The assumption of proportionality for the Cox models was tested and met. The trend test for both ED utilization and hospitalization was significant ($P < .001$) suggesting a dose-response relationship.[29]

To test the hypothesis that the benefit of increased COC may be more pronounced for known ambulatory care-sensitive conditions, we conducted a subgroup analysis of children with asthma's risk of ED visitation or hospitalization for asthma exacerbations. When only children with asthma were analyzed, there was no significant association between COC and ED visitation. However, for children covered by Medicaid, medium COC was associated with an increased risk of ED visitation (HR: 2.13 [0.99–6.67]) as was low continuity (HR: 11.76 [1.56–91]) (Table 5). Hospitalization risk for all children with asthma was significantly associated with decreased COC; medium COC (HR: 1.61 [1.10–2.38]) and low COC (HR: 1.79 [1.21–2.56]). These associations were stronger for children on Medicaid, medium (HR: 2.27 [1.00–8.33]) and low (HR: 4.16 [1.00–18.51]) (Table 6).

Comment

This study found that decreased COC is associated with both statistically and clinically significantly increased risks of hospitalization and emergency department use among children cared for in a single HMO. The point estimates for our hazard ratios for ED use for children with low COC are of similar magnitude to what we found in our previous study.[6] These results corroborate our previous findings from an outpatient teaching clinic and extend them to both risk of hospitalization as well as to a private HMO setting.

Others have found that access to care among adults is associated with decreased hospitalization rates and ED use.[30] Access to care can be meaningfully distinguished from access to a regular provider of that care. Both seem to be important. Among patients in this study, access to care should have been relatively uniform because they all belonged to

TABLE 5. Cox Proportional Hazard Model of ED Visitation for Asthma (Children With Asthma)

Variable	All Children HR [95% CI]	Non-Medicaid HR [95% CI]	Medicaid HR [95% CI]
Continuity			
High (0.38–1.0)	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Medium (0.20–0.37)	1.16 [0.82–1.50]	1.10 [.81–1.50]	2.13 [.99–6.67]
Low (0–0.19)	1.13 [0.82–1.60]	1.13 [.82–1.60]	11.76 [1.56–91]
Total outpatient visits	1.01 [1.00–1.02]	1.02 [1.01–1.03]	.98 [.94–1.01]
Age (y)	0.93 [0.89–0.95]	.93 [0.89–0.96]	0.84 [0.70–1.0]
Medicaid	1.50 [.86–2.62]	NA	NA
Female sex	.88 [.68–1.13]	.87 [0.67–1.12]	0.60 [0.50–5.70]
PCDS*	1.04 [1.00–1.09]	1.04 [1.00–1.08]	1.07 [1.06–1.08]

CI indicates confidence interval.

the same staff model HMO. Indeed one of the strengths of our study is that it was conducted within a single health system so that other aspects of care delivery aside from COC should be similar across our study groups. In effect then, we have found that above and beyond having a regular source of care, seeing a regular provider may confer additional benefit. This is consistent with what was found in a randomized controlled trial of increased COC of elderly adult patients in a single clinic.[2]

Of note, the risk associated with ED visitation for asthma exacerbation was significantly greater for Medicaid children as opposed to non-Medicaid ones. This difference was present but less pronounced for hospitalization for asthma. Because ED visitation is often initiated at the behest of parents whereas hospitalization for asthma is based on the assessment of providers, these results suggest that the parents of Medicaid children may derive greater benefit from increased COC in terms of their understanding of their child's disease and knowledge of when to seek help. A larger study of children covered by Medicaid may be warranted, as our sample of such children was relatively small.

Although the observational nature of this study precludes definitive conclusions about causal relationships, there are several key features of our findings that support a causal effect.[31] First is the strength of the association. The increased risk of ED utilization and hospitalization associated with low COC that we found is of moderate magnitude. Second, there is an apparent dose-response relationship between decreasing COC and increasing risk of ED use and hospitalization. Third, our findings are consistent with those of other studies conducted in different settings and with different patient populations.[2,4,6,8] Fourth, our use of survival analysis ensured that the appropriate temporal relationship existed between the exposure and the outcomes, specifically that the COC we measured was antecedent to ED visitation or hospitalization. It also showed that the association was not easily explained by confounding resulting from age, gender, total outpatient visits, asthma, or chronic disease burden.

Finally, there is clinical plausibility to our findings. Having consistent contact with a provider may lead to decreased ED use and hospitalization risk in a number of ways. First, compliance with medications has been shown to be affected by how well patients know their prescribing physicians.[32] For ambulatory care-sensitive conditions (eg, asthma) compliance with medication regimens could well be protective against preventable causes of ED use or hospitalization (eg, asthma exacerbation). In support of this, we found that children with asthma had a higher risk of hospitalization associated with lower continuity than was the case for all children combined. Second, greater COC has been shown to be associated with improved awareness of children's psychosocial problems.[33] This knowledge may enable providers to identify which patients can be safely managed at home or even over the phone, thereby avoiding visits to an ED and potentially even hospitalizations. Third, having a relationship with a physician might increase parents' interest in seeing that particular physician when children are nonemergently ill, which is frequently the case for children seen in EDs.[34] Parents may opt to wait 12 hours for a known provider rather than visit the ED at night to see an unknown one. Others have found that patients are willing to wait 24 hours to see their provider.[35] In fact, the efficacy of gatekeeping may be considerably

TABLE 6. Cox Proportional Hazard Model of Hospitalization for Asthma (Children With Asthma)

Variable	All Children HR [95% CI]	Non-Medicaid HR [95% CI]	Medicaid HR [95% CI]
Continuity			
High (0.36–1.0)	1.0 [Reference]	1.0 [Reference]	1.0 [Reference]
Medium (0.20–0.35)	1.61 [1.10–2.38]	1.59 [1.06–2.38]	2.27 [1.00–8.33]
Low (0–0.19)	1.79 [1.21–2.56]	1.69 [1.14–2.50]	4.16 [1.00–18.51]
Total outpatient visits	1.01 [1.00–1.02]	1.01 [1.00–1.03]	.98 [.94–1.01]
Age (y)	.86 [0.82–0.90]	.86 [0.82–0.90]	0.84 [0.70–1.0]
Medicaid	1.50 [0.78–2.89]	NA	NA
Female sex	1.12 [0.85–1.52]	1.12 [0.85–1.52]	1.23 [0.39–3.84]
PCDS*	.98 [0.87–1.11]	.98 [0.87–1.11]	0.83 [0.30–2.32]

CI indicates confidence interval.

enhanced in situations where patients and providers know each other well. Finally, ED physicians have been shown to be more likely to hospitalize children when follow-up is uncertain as may be the case for children with poor COC.[36,37]

The principal limitation of our study is the possibility of residual confounding. Although we attempted to control for disease severity by the use of 3 covariates, and each was in fact associated with increased ED and hospitalization risk, it remains possible that children with greater COC are healthier than children with less COC for reasons unrelated to increased continuity. In addition, greater parental conscientiousness or family functioning may be associated both with increased COC and with decreased likelihood of ED use or hospitalization. Parents who make an effort to establish a relationship with a regular provider may differ from those who do not in ways that are independently associated with decreased ED and hospitalization risk. It was not possible to control for this potential source of confounding in our analysis. It may be that such faithful families have better health outcomes because of unmeasured or even unmeasurable factors in much the same way as compliant patients in the placebo arm of randomized controlled trials fare better than noncompliant ones even when all identifiable potential confounders are controlled for.[38,39]

A randomized controlled trial would be the only way to control for these and other potential sources of confounding. Such a trial could not only definitively assess the benefits of increased COC but also the extent to which COC can be improved beyond what can be accomplished as a result of current efforts. Establishing a continuous relationship between patients and providers represents a complex interplay between individual enrollees and their health system. Although parents play a critical role in this process, we believe that it is unlikely that many parents are preordained to fail to establish a relationship with a regular provider; more likely, this failure represents a preventable or rectifiable disconnect between them and the health care system. Changes in structural aspects of care delivery systems are associated with changes in COC.[40] Unfortunately, the number of obstacles to establishing such consistent relationships may be increasing in today's changing health care environment.

These caveats notwithstanding, there are important implications to our findings for health systems and policy makers. Health systems may use administrative databases to identify patients with poor COC who are at significantly increased risk of both ED utilization and hospitalization. Although the numerical value of the COC index is abstruse and lacks inherent meaning, it can be used to benchmark the COC achieved for patients and identify those that have relatively poor COC based on the values at a given institution or clinic. For policymakers and practitioners, mechanisms whereby patients can maintain existing relationships with providers may need to be created and fostered.

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"Wisdom, in the end, is life with uncertainty."

—John Ralston Saul